

## Solid Earth

**ES-3 The student will demonstrate an understanding of the internal and external dynamics of solid Earth.**

**ES-3.8 Summarize the formation of ores and fossil fuels and the impact on the environment that the use of these fuels has had.**

**Taxonomy level:** 2.4-B Understand Conceptual Knowledge

**Previous/future knowledge:** Students in 8<sup>th</sup> grade (8-3.5) summarized the importance of ores and fossil fuels because of their physical and chemical properties. Students have not been introduced to how these materials formed or to the impact that their use has had on the environment.

**It is essential for students to know** how ores and fossil fuels form.

*Ore formation:*

A metal element or mineral is an *ore* if it contains a useful substance that can be mined at a profit.

- Ores form within Earth's crust as magma cools.
- Dense metallic minerals sink to the bottom of a body of magma.
- Layers of minerals accumulate and form ore deposits within the hardened magma.
- Hot mineral solutions may also spread through small cracks in rock and harden in fingerlike bands called *veins* or *lodes*.

*Fossil fuel Formation:*

Because of their organic origin, coal, petroleum, and natural gas are called *fossil fuels*.

- *Coal* is a dark-colored organic rock formed from the remains of plants that flourished millions of years ago.
  - Usually dead plants decompose, but if oxygen in a swamp area is limited and decay rate is slow, the compressed organic matter becomes coal.
- *Petroleum* and *natural gas* originated with once living organisms that died and their remains accumulated on the ocean floor and lake bottoms, buried by sediments.
  - As with coal, limited oxygen prevented the remains from decomposing completely.
  - As more and more sediments accumulated, heat and pressure increased becoming great enough to convert the remains into petroleum and natural gas.

Fossil fuels, like minerals, are nonrenewable resources that are needed in our world today, but the obtaining and use of these fuels can have an impact on the environment:

- Coal is the most abundant fossil fuel in the world. The present reserves of coal should last about 200 years.
  - *Anthracite* coal is the most efficient, cleanest burning coal, but it has the smallest reserves.
  - Most coal burned is *bituminous*.
  - The burning of all types of coal releases carbon, sulfur, and nitrogen oxides into the air causing air pollutions and acid precipitation, so safeguards are important to keep the abundance of these oxides from the air.
  - Strip mining of coal leaves deep ditches where the coal is removed, so mining companies work to ensure that the land around the mine is reclaimed as close to its natural state as possible.
- Petroleum production involves looking for oil traps in folds of the rock layers or in fracture or fault zones.
  - Oil shale contains petroleum between its layers, but the cost is great to mine it.
  - Transporting of oil must be done with care so that oil spills from tankers and pipelines do not pollute ocean waters or harm wildlife.

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### **Assessment Guidelines:**

The objective of this indicator is to *summarize* the formation of ores and fossil fuels and also to *summarize* the impact these fuels have had on the environment; therefore, the primary focus of assessment should be to generalize the major points about the formation of ores and fossil fuels and environmental impact issues regarding the use of fossil fuels.

In addition to *summarize* appropriate assessments may require students to:

- *exemplify* ways that fossil fuels impact the environment; or
- *identify* the types of fossil fuels.